FOREST PRODUCTS
Project Fact Sheet

POLYOXOMETALATE BLEACHING: AN EFFICIENT, OXYGEN-BASED, CLOSED-CYCLE TECHNOLOGY

BENEFITS

- Provides an effluent-free process
- Selectively degrades the residual lignin present in softwood kraft pulps
- Possesses the flexibility for application to pulps spanning a broad range of lignin content
- Significantly reduces consumption of electrical power
- Lowers industry's requirements for chemical feedstocks and water

APPLICATIONS

The new technology will be available to the pulp and paper industry as an economically attractive alternative to current bleaching technologies.

New Bleaching Agents Offer Savings in Energy, Chemical Feedstock, and Water

Traditional bleaching processes use large amounts of water and energy and generate large volumes of wastewater. A closed-cycle mill would produce virtually no effluent, saving chemical feedstock, energy, and water. The closed-cycle systems that have been implemented to date, however, have encountered many problems. A new bleaching process under investigation at the U.S. Department of Agriculture's (U.S.D.A.'s) Forest Products Laboratory, University of Wisconsin, and Emory University could provide a cost-effective option for a closed-cycle mill system. Polyoxometalates (POMs) have been shown to be effective agents for the highly selective bleaching of softwood kraft pulps. The bleaching mechanism appears to degrade lignin in a manner similar to that used by the enzymatic agents of a wood-rotting fungus.

Polyoxometalates have a number of extremely promising characteristics. They are highly selective with respect to their oxidative action, robust enough to withstand the elevated temperatures required in industrial reactions, chemically stable, and capable of being regenerated in a separate stage that eliminates effluent materials and completely mineralizes the organic materials produced during bleaching. The U.S. pulp and paper industry has endorsed a partnership program to translate these findings into an energy-efficient, cost-effective, commercial bleaching process for a closed-cycle mill.

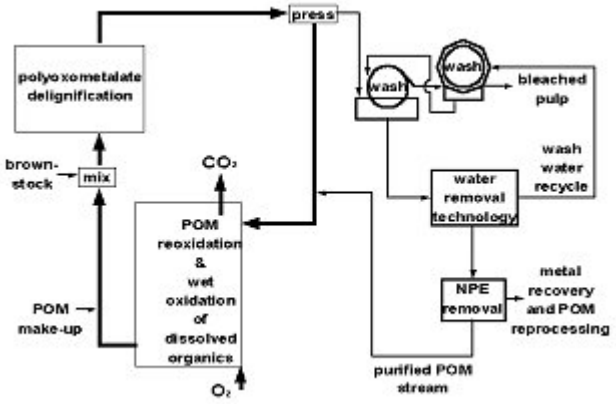


Figure 1. A diagram of the proposed polyoxometalate bleaching technology.

OFFICE OF INDUSTRIAL TECHNOLOGIES
ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

PROJECT DESCRIPTION

Goal: To develop an energy-efficient, cost-effective, commercial bleaching process for a closed-cycle mill.

In Phase I, the feasibility and generality of POM bleaching systems were demonstrated. A new class of POMs was then developed to meet the overall needs of the pulp bleaching process. Phase II will provide information necessary to construct and test a fully integrated, pilot-scale polyoxometalate bleaching plant. The focus will be on the chemistry and engineering necessary to design and integrate the five key unit operations: (1) bleaching, (2) pulp washing, (3) wash-water concentration (4) removal of inorganic contaminants carried with the pulp into the liquor stream, and (5) reoxidation/regeneration of the bleaching liquor stream with concurrent and catalytic mineralization of dissolved organic materials.

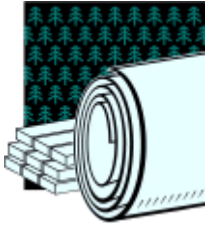
At the conclusion of five years of R&D, plans are being made to undertake the construction and testing of a pilot facility. Consideration will be given to such non-technical issues as marketing and regulatory activity.

PROGRESS & MILESTONES

- Research is underway to assemble and test bench-scale, polyoxometalate units, which industry can then carry forward into a pilot-scale application.
- The feasibility studies of Phase I successfully addressed the project's crucial technical issues.
- New polyoxometalate systems have been developed that self-buffer at near neutral pH values.

AWARDS, PATENTS, AND INVENTION RECORDS

The efforts of this research have resulted in the issuance of a number of patents in the United States and foreign countries.



PROJECT PARTNERS
University of Wisconsin
Madison, WI

U.S. Department of Agriculture Forest Products Laboratory
Madison, WI

Emory University
Atlanta, GA

FOR ADDITIONAL INFORMATION PLEASE CONTACT:

Valri Robinson
Office of Industrial Technologies
Phone: (202) 586-0937
Fax: (202) 586-3237
e-mail: valri.robinson@ee.doe.gov

Dr. Rajai Atalla
U.S.D.A. Forest Service
Forest Products Laboratory
Madison, WI
Phone: (608) 231-9443
e-mail: rhatalla@facstaff.wisc.edu

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov

Office of Industrial Technologies
Energy Efficiency and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

June 1999